Multiple Bank Mergers and Rational Foresight

Ethan Cohen-Cole and Nick Kraninger Federal Reserve Bank of Boston

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Structure of Talk

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- Paper implies differences in behavior under circumstances of multiple matching

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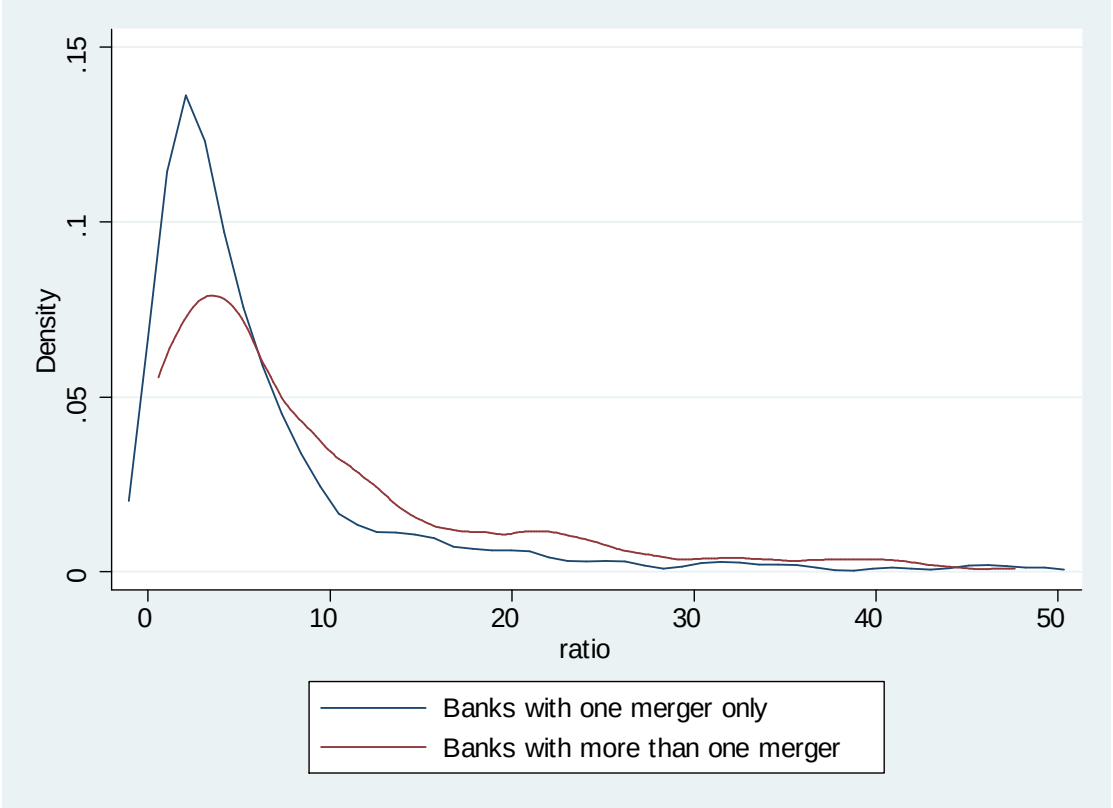
  - Adds some elements of foresight
  - Optimal merger strategy depends on your relative size in industry

Empirics of merger distributions

- Distribution of first merger ratio of banks that merge once / more than once



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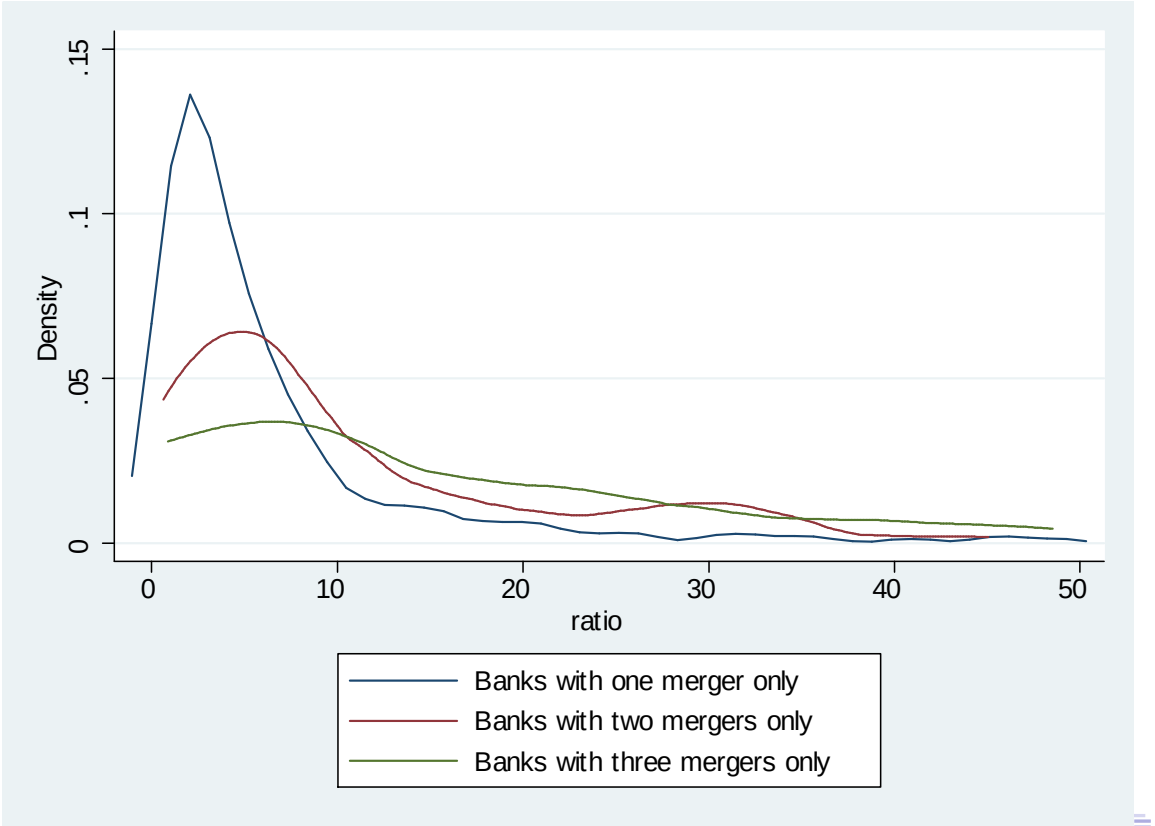

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- Suggests a need for a model that links the merger decisions
- Essentially, need a matching model with foresight.

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- Examines merger dynamics in the banking industry since 1986

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- First stage problem requires agents x_a, x_b to consider the options of x
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  - This is a function of both the partner x_a or x_b and the possible partners y in the next round.

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- Paper proves existence of SE for the modeled two-stage game

Match Surplus Distribution and Matching Sets

- One-stage match: $V(z)$ - unmatched value for z.

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- Note:
  - Second stage payoff is stage two payoff minus a share of stage one due to other agent.

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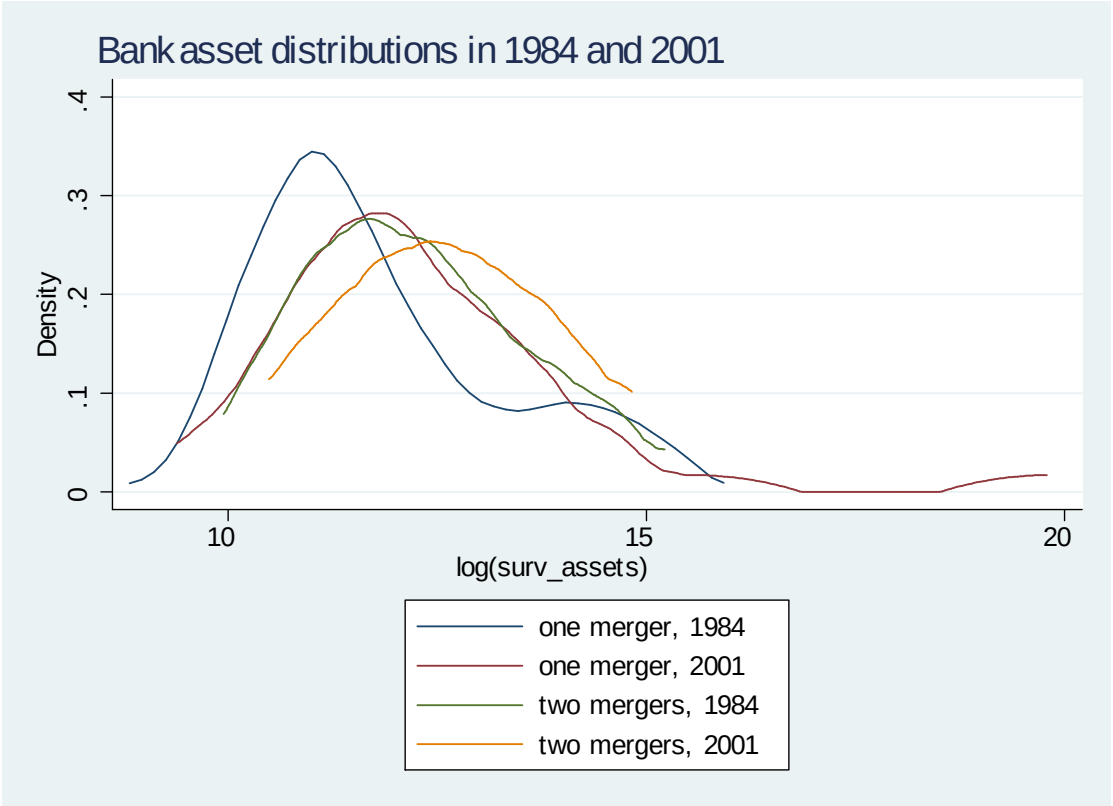
- Charts again:

Empirics, Again

- Comparison of bank asset distributions 1984/2002.



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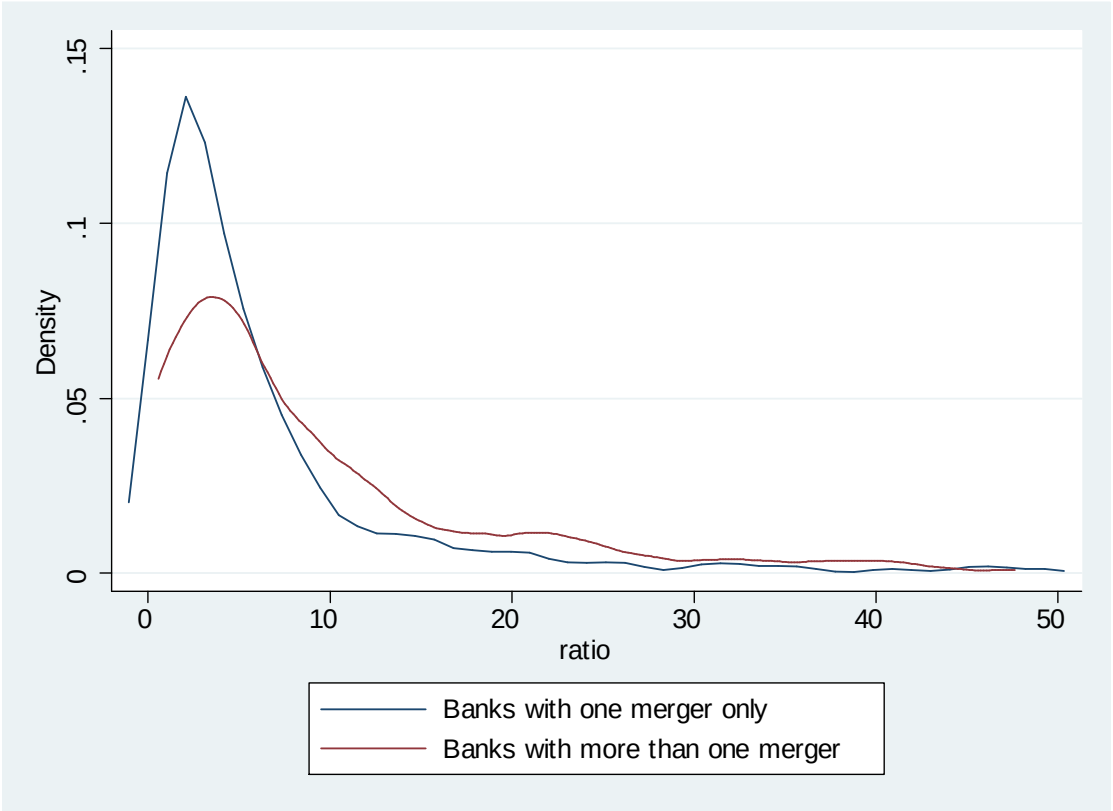

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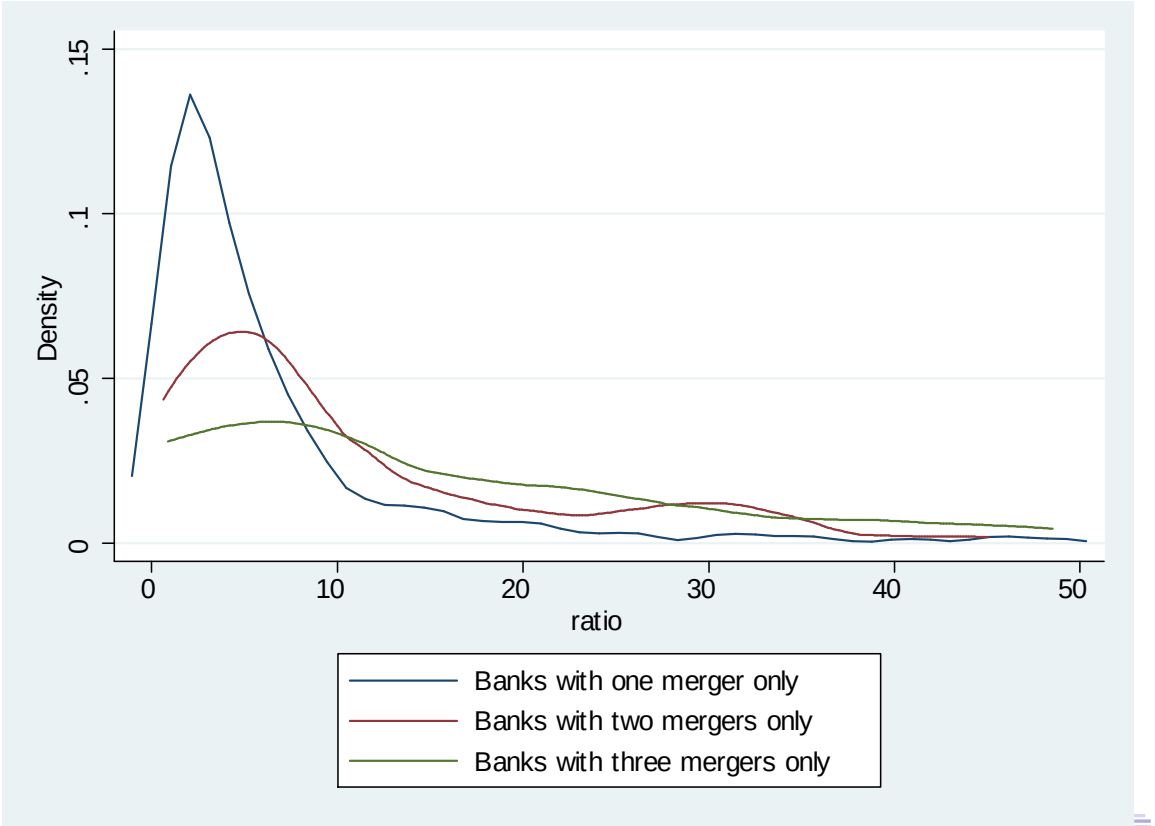

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  - Ex-ante, the expectations of second-period actions should impact the choice of the first merger
- We will look to identify 'regimes'; that is, we look to find an endogenous relationship;
  - A model with exchangeability should find no relationship between first and second period mergers

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- Use asset size as key measure (ratio of asset size of acquiring bank to acquired)

Results1: Current Merger Ratio on Future Ratio

ratio	1st merger		2nd merger	merger 1/2	merger 1/3		merger 2/3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2nd ratio	.419	.391		.230	.399	.326	
	(.059)***	(.079)***		(.118)*	(.135)***	(.152)**	
3rd ratio		.130	.418			.255	.379
		(.081)	(.084)***			(.105)**	(.188)**
cons	6.228	6.492	11.643	5.466	6.298	3.534	9.826
	(.775)***	(1.378)***	(1.595)***	(1.037)***	(1.965)***	(1.774)**	(2.775)***

- merger x/y: merger number x for institutions with y mergers.

Results2: Current Merger Ratio on Prior Ratio

ratio	3rd merger		2nd merger	merger 2/2	merger 3/3		merger 2/3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2nd ratio	.357	.282			.267	.119	
	(.064)***	(.085)***			(.123)**	(.141)	
1st ratio		.169	.606	.454		.374	.620
		(.109)	(.069)***	(.159)***		(.200)*	(.198)***
cons	12.359	11.005	7.871	6.925	11.374	8.932	7.665
	(1.397)***	(1.444)***	(.884)***	(1.378)***	(2.284)***	(2.323)***	(2.098)***

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  - Deviation from expected of first four moments of asset distribution
  - e.g. Predict mean using ARMA process, residual is valid instrument

Results - 1st stage

ratio	(1)	(2)	(3)	(4)
mean-resid	-7.02e-06	5.51e-06	-2.50e-06	-2.23e-06
	(1.00e-05)	(.00002)	(.00002)	(.00002)
var-resid		-1.71e-14	-9.05e-15	-9.06e-15
		(2.16e-14)	(2.37e-14)	(2.37e-14)
skew-resid			-.416	-.568
			(.536)	(1.695)
kurt-resid				.002
				(.023)

Results - 2nd stage

ratio	all mergers	1st merger	2nd merger	3rd merger
	(1)	(2)	(3)	(4)
next merger ratio	1.470	.844	.881	.281
	(.512)***	(.247)***	(.222)***	(.273)

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	(.090)***	(.114)***		(.105)*	(.389)	(.396)	
3rd ratio		.161	.426			.176	.477
		(.094)*	(.133)***			(.230)	(.176)***
surv-ka	-42.997	-83.860	107.679	-15.885	-50.919	-70.834	105.426
	(21.442)**	(50.425)*	(86.216)	(19.447)	(89.118)	(86.784)	(175.626)
surv-roa	-149.979	-555.545	-64.830	-91.866	-865.251	-1608.147	2577.924
	(262.996)	(882.582)	(1476.398)	(192.249)	(2694.466)	(2315.166)	(3000.590)
surv-ineff	-.187	-.848	.629	-.094	-2.444	-1.592	1.196
	(.121)	(.589)	(.487)	(.090)	(1.090)**	(1.148)	(1.439)
surv-age	.00002	.0003	.0008	-.00006	.0005	.0003	.0003
	(.00008)	(.0003)	(.0004)*	(.00004)	(.0003)	(.0004)	(.0005)
non-ka	18.657	17.431	40.826	19.467	-35.226	-48.785	59.370
	(20.913)	(40.412)	(56.420)	(21.948)	(86.500)	(89.859)	(77.985)
non-roa	-207.493	-256.104	25.101	-92.923	1277.346	2007.776	-239.860
	(101.051)**	(336.519)	(147.754)	(98.917)	(1936.245)	(2012.400)	(1571.001)
non-ineff	.063	1.751	.539	.012	6.204	3.371	.403
	(.082)	(1.857)	(.199)***	(.068)	(2.886)**	(3.345)	(.161)**
non-age	-.0001	-.0002	-.0002	-3.74e-06	-.0004	-.0003	-.0002
	(.00005)***	(.00008)***	(.0001)*	(.00004)	(.0002)*	(.0002)	(.0002)

- merger x/y: merger number x for institutions with y mergers.

Results2: Current Merger Ratio on Prior Ratio

ratio	3rd merger		2nd merger	merger 2/2	merger 3/3		merger 2/3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2nd ratio	.329	.289			.318	.357	
	(.098)***	(.095)***			(.217)	(.222)	
1st ratio		.152	.547	.376		.269	.479
		(.131)	(.080)***	(.174)**		(.144)*	(.175)***
surv-ka	-197.858	-187.474	13.447	-29.966	-257.673	-253.378	33.744
	(58.654)***	(57.519)***	(31.431)	(25.917)	(57.983)***	(56.805)***	(143.771)
surv-roa	508.106	408.549	-163.806	-486.930	1005.120	1240.166	3942.209
	(1347.544)	(1368.319)	(261.444)	(303.852)	(1922.747)	(1745.945)	(3283.979)
surv-ineff	-.017	-.018	.053	-.027	-.013	-.016	.922
	(.010)*	(.011)*	(.102)	(.040)	(.012)	(.013)	(1.967)
surv-age	.0003	.0002	.0001	9.14e-06	.0001	1.00e-05	.0003
	(.0003)	(.0003)	(.00008)*	(.00005)	(.0004)	(.0003)	(.0004)
non-ka	98.163	106.287	37.788	52.895	181.192	193.902	78.172
	(54.385)*	(55.319)*	(31.218)	(26.664)**	(86.661)**	(80.445)**	(69.566)
non-roa	58.805	39.604	-42.207	13.362	-253.256	-266.862	-934.495
	(116.437)	(118.535)	(127.686)	(135.399)	(129.344)*	(117.510)**	(1381.286)
non-ineff	.525	.525	.253	.870	1.603	1.711	.400
	(.457)	(.462)	(.143)*	(.457)*	(.682)**	(.710)**	(.206)*
non-age	.00007	.00006	-.0002	-.0001	-.0002	-.0003	-.0003
	(.0001)	(.0001)	(.00007)**	(.00006)*	(.0001)	(.0001)**	(.0002)

- merger x/y: merger number x for institutions with y mergers.

Results - Summary

Panel A	
first-ratio on second-ratio	**first-ratio on third-ratio**
$ratio_{1it} = \alpha + \beta_1 E_t ratio_{2it'} + \beta_2 X_{it} + \varepsilon_i$	$ratio_{1it} = \alpha + \beta_1 E_t ratio_{3it''} + \beta_2 X_{it} + \varepsilon_i$
$\beta_1 = 0.419$	$\beta_1 = 0.293$
	second-ratio on third-ratio
	$ratio_{2it\prime} = \alpha + \beta_1 E_t ratio_{3it''} + \beta_2 X_{it\prime} + \varepsilon_i$
	$\beta_1 = 0.418$
Panel B	
second-ratio on first-ratio	**third-ratio on first-ratio**
$ratio_{2it'} = \alpha + \beta_1 ratio_{1it} + \beta_2 EX_{it'} + \varepsilon_i$	$ratio_{3it''} = \alpha + \beta_1 ratio_{1it} + \beta_2 EX_{it''} + \varepsilon_i$
$\beta_1 = 0.606$	$\beta_1 = 0.333$
	third-ratio on second-ratio
	$ratio_{3it''} = \alpha + \beta_1 ratio_{2it\prime} + \beta_2 EX_{it''} + \varepsilon_i$
	$\beta_1 = 0.357$

Wrap-Up

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- Paper finds existence of search equilibrium in a two-stage matching game
- Agent foresight in these games leads to different matching choices in each stage and different long run patterns
- Found evidence of this in bank merger patterns